STEREOTYPE THREAT AND AFFIRMATION: THE INTERACTIVE EFFECT OF DOMAIN AND GENDER IDENTIFICATION, AND DIFFERENT TYPES OF AFFIRMATION ON WOMEN'S MATH PERFORMANCE

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ABSTRACT

This research applies the affirmation theory to situations of stereotype threat. We examined how group-affirmation influences math performance of women under stereotype threat and whether group-affirmation effects depend on the beliefs women hold regarding gender and math (i.e., how much they identify with the domain of mathematics and their gender). In the current study, the effects of group-affirmation were compared to self-affirmation, a coping technique successfully used to alleviate stereotype threat. One hundred and fifty-nine female college students were exposed to stereotype threat and subsequently given the opportunity to either affirm as individuals (self-affirmation) or group members (group-affirmation). Next, they took a difficult math test. We measured participants' identification with their gender and mathematics. We hypothesized that the effects of different types of affirmation (self vs. group) would depend on the level of gender and math identification. We found that math, but not gender identification, moderated the effects of self and group-affirmation. Women who were highly identified with math and affirmed as members of the stereotyped group (i.e., as women) underperformed compared to women highly identified with math who self-affirmed. We hypothesize that group-affirmation was harmful to women highly identified with math because it activated the stigmatized identity. When group-affirmation is related to the stigmatized identity, it may intensify the stereotype threat instead of lifting the

threat. Therefore, other methods focused on comparisons with specific in-group members who are doing well in a stereotyped domain or using other positive group identities different than the stigmatized group could be more effective than affirming as a stigmatized group member in stereotype threat situation.

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INTRODUCTION

Recent reports show that girls are as proficient in mathematics as boys (Else-Quest, Hyde, & Linn, 2010; Hyde, Lindberg, Linn, Ellis, & Williams, 2008), but stereotypes about women's poor math abilities persist and may contribute to women's underperformance in mathematics (Nosek et al., 2009). One proposed contributor to this underperformance is stereotype threat (e.g., Davies, Spencer, Quinn, & Gerhardstein, 2002; Smith & White, 2002; Spencer, Steele, & Quinn, 1999; Wheeler & Petty, 2001), which is defined as "being at risk of confirming, as a self-characteristic, a negative stereotype about one's group" (Steele & Aronson, 1995, p. 797). Stereotypes about women's poor math abilities can not only harm math performance via stereotype threat, but they also interfere with women's beliefs about how good they can be at math and how well they can control their performance in math. Girls feel less confident and more anxious about their abilities in mathematics than boys (Else-Quest et al., 2010). They are also less motivated to study math when compared to boys (Else-Quest et al., 2010), and less willing to select careers in math-related disciplines (e.g., Davies et al., 2002; Dey & Hill, 2007; Smith, Sansone, & White, 2007). Furthermore, women tend to be less self-identified with mathematics than men (Smith, Morgan, & White, 2005; Smith & White, 2001). All of these factors may be related to women being underrepresented in STEM (science, technology, engineering, mathematics) professions (Ceci, Williams, & Barnett, 2009).

There are ways to help women overcome the effects of stereotype threat regarding poor performance in mathematics. Stereotype threat can be alleviated by, for example, leading women to believe that stereotypes are not applicable to them (e.g., Keller, 2007; Spencer et al., 1999), by disidentifying with feminine characteristics (Pronin, Steele, & Ross, 2004), by deemphasizing threatened social identities (e.g., Ambady, Paik, Steele, Owen-Smith, & Mitchell, 2004), by emphasizing positive social identities (e.g., Gresky, Ten Eyck, Lord, & McIntyre, 2005; Rydell, McConnell, & Beilock, 2009; Shih, Pittinsky, & Ambady, 1999), by providing positive role models (Marx & Roman, 2002; McIntyre, Paulson, & Lord, 2003), or through self-affirmation (Cohen, Garcia, Apfel, & Master, 2006; Martens, Johns, Greenberg, & Schimel, 2006).

The aim of the current study is to test whether group-affirmation can alleviate stereotype threat in women. The effectiveness of the strategies of coping with stereotype threat as well as the stereotype threat effects may be influenced by the beliefs women hold regarding gender and math (i.e., how much they identify with math and gender). Therefore, in the current study, we aim to test whether coping effects of group-affirmation depend on how much women identify with gender and the domain of mathematics. As our test, we compare self-affirmation, a coping technique successfully used in stereotype threat research (Cohen et al., 2006; Martens et al., 2006), to group-affirmation, a technique which has received less attention in stereotype threat research (Derks, van Laar, & Ellemers, 2009).

Below, we briefly review stereotype threat and how it has been studied, after which we review the literature on the effects of math and gender identification on susceptibility to stereotype threat. Subsequently, we will describe self-affirmation as a

technique of coping with stereotype threat and introduce a relatively new coping technique called group-affirmation. We provide evidence suggesting that group-affirmation can have a different effect on stereotype threatened women depending on their math-gender identification. Furthermore, we explain why self-affirmation alleviates stereotype threat and we argue that group-affirmation works through the same mechanisms in the context of stereotype threat.

Stereotype Threat

Most of the work that has explored the effects of gender stereotypes on performance uses the theory of stereotype threat (Steele, 1997; Steele & Aronson, 1995), or social identity threat (Steele, Spencer, & Aronson, 2002). According to stereotype threat theory, people experience apprehension when they are about to perform in a domain in which their group is stereotyped as doing poorly. This apprehension in stereotype threat is accompanied by a desire not to confirm the negative stereotypes. Unfortunately, the attempts to disconfirm the stereotypes may lead to further supporting the stereotype by performing poorly in a stereotype relevant domain (e.g., Spencer et al., 1999; Steele, 1997).

For example, in the study by Spencer et al. (1999), male and female participants were asked to take a difficult math test. Before the test, the experimenters activated stereotype threat for some participants and nullified the threat for others. In order to evoke the threat, researchers told the first participant group that women tended to do more poorly on the test than men, because of its emphasis on math skills. In order to nullify the threat, researchers told the second participant group that women and men did

equally well on the test. It turned out that those women who heard that females did worse on the test than males actually performed worse than participants in other groups. On the other hand, women who heard that the test was gender fair performed on the same level as men in either group. Thus, the study showed that women who experienced stereotype threat performed below their abilities in the domain relevant to the stereotype about female underperformance.

Stereotype threat theory has delineated the criteria for stereotype threat occurrence. Stereotype threat occurs when an individual's performance in a stereotyped domain is subject to evaluation, and one's in-group can be judged based on this evaluation (Steele, 1997). For example, when a woman is about to perform on a math test, the way she performs might have an impact on the evaluations of women in general. If she performs well, she could disconfirm the stereotype about women doing poorly in mathematics. If her performance is bad, she could confirm the stereotype about women in mathematics. Furthermore, a person under stereotype threat does not have to believe that the stereotype is true, but the stereotype needs to be activated explicitly or implicitly in this persons' mind as relevant to their performance (Smith & White, 2002; Steele & Aronson, 1995; Steele et al., 2002). Finally, the task being performed under stereotype threat needs to be difficult and challenging in order to create the fear of confirming the stereotype (e.g., Study 1 of Keller, 2007; Spencer et al., 1999).

Moderating Role of Gender and Domain Identification in Stereotype Threat

Three important concepts are activated in a person's mind under stereotype threat: the group relevant to the stereotype, ability domain, and the self (Marx, Stapel, & Muller, 2005; Schmader, Johns, & Forbes, 2008), but people differ in how much they identify with their group and ability domain. These individual differences can influence how people react to stereotype threat and affirmation. More specifically, some women consider both mathematics and gender to be important for their self-concept, whereas other women do not identify strongly with either gender or math (Derks et al., 2009; Schmader, 2002; Smith & White, 2001; Steele, 1997). Stereotype threat is especially harmful to women who highly identify with gender and math. Women for whom gender is important are more motivated to maintain an image of their group that would be consistent with their self-image (i.e., all women as being capable, having free will, being worthy, and able to control their outcomes, Schmader, 2002; Tajfel & Turner, 1986). Therefore, these women experience greater threat at the suggestion that women in general do poorly in mathematics when compared to men and they do worse in mathematics under stereotype threat than women who report low gender identification (Schmader, 2002; Rydell et al., 2009). Similarly, women identified with mathematics perceive themselves as capable and able to control their performance in math (Smith & White, 2001; Steele, 1997). Therefore, these women should experience greater threat at the suggestion that women in general do poorly in mathematics when compared to men. According to a review of stereotype threat research, women who strongly and moderately

identify with math underperform in mathematics under stereotype threat compared to women who do not experience stereotype threat (Nguyen & Ryan, 2008).

Why Does Stereotype Threat Impair Performance?

Why do members of stereotyped groups underperform under stereotype threat? Steele and Aronson (1995) proposed that underperformance could be mediated by stereotype-related anxiety, worry, self-consciousness, inability to focus attention on a task, or withdrawal of effort. However, Steele and Aronson (1995) were not able to show that any of the above-mentioned mechanisms were responsible for stereotype threat induced underperformance, which led them a conclusion that people under stereotype threat tried hard to complete the task, but the way they processed information during the task was inefficient. More recently, researchers have been pointing to different mediators of stereotype threat such as anxiety (Smith, 2004; Spencer et al., 1999), performance expectancies (Steele et al., 2002) or ideomotor mechanisms (Wheeler & Petty, 2001). In our study, we focus on the idea that stereotype threat impairs performance because it poses a threat to people's self-integrity (Martens et al., 2006; Rydell & Boucher, 2010; Rydell et al., 2009; Schmader et al., 2008). What we mean by self-integrity is that people want to perceive themselves in a positive way, as consistent, worthy, and having free choice and the ability to control their performance outcomes (e.g., Swann, 1987; Taylor & Brown, 1988). In this way, they can maintain a stable, consistent, and positive view of themselves and sense of self-integrity (Steele, 1988). Stereotypes pose a threat to self-integrity because negative information contained in the stereotype challenges the positive and consistent view of oneself. For example, if a woman perceives herself as competent

and able to do well in math and she receives stereotypical information about women doing poorly in math, this information is inconsistent with how she sees herself. That is, "I am good at math" and "I am a good, intelligent person" is not consistent with "I am a woman" (Nosek, Banaji, & Greenwald, 2002; Rydell et al., 2009). This inconsistency in turn could be harmful for self-integrity (Rydell et al., 2009, Rydell et al., 2010, Schmader et al., 2008).

When women hold an inconsistent view about their mathematic ability and gender, it may interfere with their math performance because instead of focusing fully on the task at hand, they inadvertently expend cognitive resources to resolve the inconsistency and restore the self-integrity (Schmader et al., 2008; Rydell et al., 2009). Women try to regain self-integrity and perform on a stereotype-relevant task at the same time; thus, they do not fully engage the mental resources necessary to perform according to their abilities and they underperform in a stereotyped domain (Rydell et al., 2009; Schmader et al., 2008).

Women perform better under stereotype threat if they have consistent and positive beliefs about self, math, and gender (i.e., if they think they can do well in math and that their group can do well) because they can focus their cognitive resources more on the task at hand instead of resolving the issues of inconsistency (Schmader, 2002; Schmader et al., 2008). This idea not only helps us to understand when and why stereotypes pose a threat to women, but it also suggests coping techniques which could be used to alleviate stereotype threat. One possible technique of coping with stereotype threat is affirmation. Research shows that affirmation can restore the integrity of the self and self-consistency when the self is threatened (Steele, 1988). If stereotypes pose a threat to a person's self-

integrity and consistency of self, then affirmation may help to overcome the negative effects of stereotype threat by restoring self-integrity and resolving inconsistency (Martens et al., 2008; Steele, 1988).

Affirmation Helps Women to Combat Stereotype Threat

The present study will look into group-affirmation as a possible technique for reducing negative consequences of stereotype threat. We will also compare group-affirmation to self-affirmation. It has been found that people show better performance in stigmatized domains when they have a chance to self-affirm after being exposed to negative stereotypes about their group (Cohen et al., 2006; Frantz, Cuddy, Burnett, Ray, & Hart, 2004; Martens et al., 2006). We want to find out if group-affirmation can bring similar effects for women exposed to stereotype threat.

Self-affirmation is defined as thinking positive thoughts about the self or reflecting on one's values and beliefs (Martens et al., 2006; Steele, 1988). In the study investigating the effects of self-affirmation on stereotype threat, Martens and colleagues (2006) gave the participants a difficult mental rotation test to complete. Before the test, the experimenters reminded the participants about a common belief that women usually did poorly on mental rotation tasks compared to men, as a way to evoke stereotype threat in female participants. Next, the experimenters assigned all participants to two conditions, self-affirmation and no-affirmation. In the self-affirmation condition, the experimenters asked the participants to reflect on their most important personal values. In the no-affirmation condition the experimenters asked the participants to reflect on the values viewed as the least important to other people. Finally, the participants completed a

Mental Rotation Test. The female participants who had a chance to self-affirm performed significantly better on the test than women who did not have a chance to self-affirm. Thus, females were able to reduce the effects of stereotype threat as a result of self-affirmation. In another study, Cohen and colleagues (2006) tested whether self-affirmation can enhance the academic performance of stereotype threatened minority students. It turned out that those African American students who self-affirmed at the beginning of the school semester finished that semester with a better GPA than African American students who did not have a chance to self-affirm.

Why does self-affirmation reduce stereotype threat effects? Self-affirmation helps people who experience stereotype threat to restore self-integrity (Martens et al., 2006), by reinforcing a positive propositional relationship between the self and the domain, i.e., "I am a good, intelligent person," "I am good at math" (Schmader et al., 2008). As a consequence, people are able to focus their cognitive resources on the task at hand instead of engaging in restoring their self-integrity (Rydell et al., 2009; Rydell et al. 2010; Schmader et al., 2008).

Research has shown that members of stigmatized groups are able to perform better under stereotype threat when given the opportunity to self-affirm (Cohen et al., 2006; Martens et al., 2006). It is important to note that self-affirmation does not cause a general performance boost. In the study by Martens et al. (2006), self-affirmation had no effect on male participants. Similarly, in the study by Cohen et al. (2006), self-affirmation had no effect on White students. If self-affirmation had caused a general performance boost for all participants, then those nonstigmatized would have performed significantly better in the self-affirmation condition compared to those nonstigmatized in

the no-affirmation condition. Self-affirmation helped only stigmatized participants because the negative stereotype applied only to them; thus it was only they who felt threatened in the study and could benefit from self-affirmation (e.g., Martens et al., 2006).

The Potential Role of Group-affirmation in Stereotype Threat

Self-affirmation reduces the negative consequences of stereotype threat but stereotypes are about groups, and stereotype threat is about confirming stereotypes about a stigmatized group. When group members are exposed to positive group characteristics, they are able to overcome the negative effects of stereotype threat (e.g., Marx & Roman, 2002; McIntyre et al., 2003) because priming positive social identities can help maintain the feelings of self-worth while under threat (Rydell et al., 2009). For example, female college students who were primed with both positive (i.e., college students) and negative (i.e., women) social identities chose to identify more with a positive social identity before they took a math test. As a result, these females performed better on a math test than females in whom only the negative identity was primed. Women exposed to both positive and negative social identities chose to align themselves more with the positive social identity to maintain the feelings of self-integrity (Rydell et al., 2009). However, what happens when people who face stereotype threat cannot or do not want to disidentify or leave the stereotyped group and identify with a more positive social identity? In such situations, they could maintain a sense of self-worth by thinking positive things about the negatively stereotyped group (Tajfel & Turner, 1986).

People can affirm the negatively stereotyped group when they express freely group values, when they think about the strengths of the group, or recollect good things fellow group members have done. This technique is called group-affirmation (Sherman, Kinias, Major, Kim, & Prenovost, 2007). We propose that group-affirmation can help people highly identified with their group to combat the negative effects of stereotype threat.

How can people use group-affirmation to enhance their performance under stereotype threat? We argue that, similar to self-affirmation, group-affirmation can help people under stereotype threat to resolve the inconsistency (i.e., "I am a good, intelligent person, and a woman" and "I am good at math") and regain the feelings of self-integrity, by giving the opportunity to focus on positive group characteristics.

Moderating Role of Gender Identification in Group-affirmation

So far, the studies have looked at the effects of group-affirmation on motivation and acceptance of threatening information. The findings show that group-affirmation helps people who are highly identified with their group to be less biased in response to threatening information about their group (Sherman et al., 2007). Furthermore, group-affirmation boosts motivation in people highly identified with their group to perform well in a stigmatized domain (Derks et al., 2009). On the other hand, the same studies show that those who are less identified with their group do not benefit from group-affirmation. In the studies by Sherman et al. (2007), participants who did not identify strongly with their group still showed a bias in response to the threatening information about their group. In the studies by Derks and colleagues (2009), people who were less identified

with the group were more motivated to boost their individual outcomes at the expense of the group outcomes. Additionally, the theory of affirmation states that in order to reduce the threat, people who are threatened should affirm important elements of self, otherwise affirmation is not going to be successful in reducing threats to self (Steele, 1988; Steele & Liu, 1983). If a group is not important for the self, affirming it will not help and may even be harmful. For women less identified with gender, group-affirmation may feel unnatural and threatening. When they affirm their gender, it is inconsistent with how they see themselves. Moreover, they are categorized by others as women when they do not want to use that category for themselves, which may evoke categorization threat and could negatively affect their performance (e.g., Derks et al., 2009). Lastly, specifically in a stereotype threat situation, women may disidentify with their gender to cope with the threat (Pronin et al., 2004; Steele, 1997); therefore, affirming the group they do not want to identify with may be counterproductive.

Hypotheses for the Current Study

People react differently to stereotype threat depending on how much they identify with their group (Rydell et al., 2009; Schmader, 2008) and the ability domain (Nguyen & Ryan, 2008). Additionally, people react differently to self and group-affirmation depending on how much they identify with their group (Derks et al., 2009; Sherman et al., 2007). Based on what we know from the previous studies, we can make a prediction that the effects of different types of affirmation (self vs. group) will depend on the level of gender and math identification (low vs. high). Both self and group-affirmation will reduce the stereotype threat and enhance the math performance for women who strongly

identify with gender and math, compared to women who strongly identify with gender but do not strongly identify with math. Group-affirmation may not have an impact strong enough to reduce harmful effects of the threat or may even be harmful for women who do not strongly identify with their gender, but identify strongly with mathematics compared to self-affirmation.

METHOD

Participants and Design

The participants in the study were 159 female undergraduates recruited from introductory psychology courses (mean age = 20 years). Eleven participants who took part in the study were not included in the statistical analyses because they were international students. We did not want cultural and language differences to influence the results. The students were participating in the experiment either as part of a course requirement or in order to obtain extra credit.

Before the actual experiment, the participants completed two questionnaires in mass testing: Domain Identification Measure (DIM), which determines the importance of mathematics in participants' lives (e.g., "Math is one of my best subjects;" "I have always done well in Math;" Smith & White, 2001), and Gender Identification Scale, which determines the importance of gender for the participants (e.g., "Being a woman/man is an important part of my self-image;" "Being a woman/man is an important reflection of who I am;" Schmader, 2002).

The study is a between-participants factorial design with participants randomly assigned to three conditions: self-affirmation, group-affirmation, and no-affirmation.

Procedure

We contacted female participants who completed mass testing and invited them to take part in our study, which we described as an evaluation of a newly developed academic exam. Participants were brought to the lab and seated in separate cubicles. The rest of the study was administered on the computer.

Stereotype threat manipulation

After the participants read and signed the informed consent, they read a short description of the math exam, which included two sample problems. Participants were told that in order to get some background about the test, they would read the included journal article entitled "Gender Differences in Mathematical Ability: Fact or Artifact?" The article described recent findings suggesting that there were gender differences in mathematics achievement (i.e., males outperform females). The article's content was fictitious and was given to the participants in order to evoke stereotype threat (see Smith & White, 2002; Thoman, White, Yamawaki, & Koishi, 2008).

Affirmation manipulation

Next, the participants filled out a survey in which they had to answer questions about values. We explained that the survey was a part of a different study unrelated to the math test.

We adapted the survey about values from the studies by Martens et al. (2006) and Sherman et al. (2007). The values used in the form are those of friendship, family, education, and economics originally taken from Allport, Vernon, and Lindzey (1960). In

the self-affirmation condition, participants got a list of values, which they had to rank in order of personal importance. Next, they had to write about the value that was most important to them. In the group-affirmation condition, participants got the same list of values, but they had to rank the values in order of importance for their gender and then write about the most important value for their gender. In the no-affirmation condition, participants got the same list of values and they had to rank the values in order of importance for other people and then write about the value that was the least important for others.

Pre-exam questionnaire

Next, participants completed the pre-exam questionnaire, which assessed their perceptions of the exam and expectations about their performance on the exam (e.g., how well they will do on the exam, their commitment to do best on the exam, motivation to perform, anxiety about taking the exam, perceived academic knowledge, perceived difficulty of the exam, and effort they will make to perform on the exam).

Math exam

Subsequently, the participants took the math test. The math exam was in a multiple-choice format delivered in two separate 10-minute sections, 10 problems per section, with each section preceded by a couple of practice problems (e.g., Thoman et al., 2008). The exam was delivered in two separate sections due to the differences in the difficulty level. Section one was designed to be less advanced than section two. Math problems in section one were derived from the Graduate Record Exam (GRE) general

quantitative test. Math problems in the second section were derived from the GRE Subject Test in Mathematics (as in Spencer et al., 1999). Since the second section was designed to be more difficult than section one, we expected the stereotype threat effects to be more pronounced in the more difficult second section, consistent with stereotype threat theory (Spencer et al., 1999).

Postexam measures

After the exam, participants answered questions about the exam's difficulty, validity, and usefulness, how interesting versus boring it was, and how much they enjoyed working on the exam. Next, the participants filled out the Domain Identification Measure, and the Gender Identification Scale.

In order to check whether the stereotype was successfully conveyed, we asked participants to answer a free recall question about what they remembered from the article given to them. Next, they had to answer a multiple-choice question about what they were told in the laboratory regarding gender differences in math ability. Following completion of the test and materials, we debriefed the participants and gave them research credit.

RESULTS

Manipulation Check

Stereotype threat related information was successfully conveyed to the participants. When we asked the participants to recall the specific information given to them in the stereotype threat manipulation, 95% of them reported this information accurately across both open-ended and multiple-choice questions. The participants who failed to report the information correctly were distributed equally across conditions ($\chi^2(2)=5.63$, $p=0.223$). We did not include a manipulation check for affirmation in our study. However, we found that the choice of the most important value did not depend on the condition ($\chi^2(18)=16.18$, $p=0.58$). The value ranked first by women in all three conditions was either political activism, or business and money.

Domain Identification and Group Identification

We calculated the domain identification score by summing the items on the Domain Identification Scale. The participants' scores on the Domain Identification Measure obtained through mass testing ($\alpha = 0.909$) did not differ significantly across conditions ($M_{\text{no-affirm}} = 28.5$ vs. $M_{\text{self-affirm}} = 27.8$ vs. $M_{\text{group-affirm}} = 27.4$; $F(2,147) = 0.245$, $p = 0.783$). We calculated the gender identification score by adding and averaging the items on the scale. The scores on Gender Identification Scale ($\alpha = 0.81$) measured in mass testing also did not differ significantly across conditions ($M_{\text{no-affirm}} = 4$ vs. $M_{\text{self-affirm}}$

= 3.88 vs. $M_{\text{group-affirm}} = 4$; $F(2,147) = 0.812$, $p = 0.446$). An average woman in our study strongly identified with gender ($M = 4$, $SD = 0.768$) and moderately with math ($M = 28$, $SD = 7.51$).

Overview of Regression Analyses

We conducted a series of multiple regression analyses to test our predictions. First, we contrast coded the affirmation level. We used three sets of orthogonal contrast codes to compare the two affirmation conditions (self and group) with each other and with the no-affirmation condition (see Table 1). In Step 1, we entered the standardized gender and domain identification score together with each set of contrasts. In Step 2, we entered the two-way interactions between each contrast, gender identification, and the domain identification. In Step 3, we entered the 3-way interactions between each contrast, gender, and domain identification to test the predictions about the moderating effects of gender and domain identification. All significant interaction effects were subsequently investigated by calculating simple slopes for low (-1 *SD*) and high (+1 *SD*) domain and gender identification (Aiken & West, 1991).

Pre-exam questionnaire

Affirmation level did not affect participants' predictions about how well they would do on the exam, their commitment, anxiety level, perceived academic knowledge, perceived difficulty of the exam, or effort. However, affirmation level did predict the participants' motivation to perform well on the exam. Women in the group-affirmation

Table 1. All orthogonal contrasts used in the experiment to code main effects.

	No-affirmation	Self-affirmation	Group-affirmation
self-affirmation vs. group-affirmation	0	1	-1
affirmation (self and group) vs. no-affirmation	-1	0.5	0.5
no-affirmation vs. self-affirmation	-1	1	0
no and self-affirmation vs. group-affirmation	-1	-1	2
no-affirmation vs. group-affirmation	-1	0	1
no and group-affirmation vs. self-affirmation	-1	2	-1

condition were more motivated to perform well on the exam compared to women in the self-affirmation condition (B = -0.478, $t(143)$ = -2.44, p=0.016, semipartial r^2 = 0.036), and the no-affirmation condition (B = 0.37, $t(143)$ = 1.88, p = 0.062, semipartial r^2 = 0.021).

Math test score

The measure of test performance was the number of items answered correctly (e.g., Aronson et al., 1999). We calculated separate indexes of math performance for section one and section two and for the overall exam score.[1] We designed section two to

[1] Although our main interest was to analyze the results for section one and two separately, we also analyzed the results for the overall math performance (the two sections combined). The pattern of results was similar to what we got for section two of the test. Overall math performance was predicted by domain identification measured in mass testing (B = 0.151, $t(136)$ = 5.07, $p < 0.0001$, semipartial r^2 = 0.146), and gender identification measured in mass testing (B = 0.645, $t(136)$ = 2.15, p = 0.033, semipartial r^2 = 0.026). These two main effects were qualified by a marginally significant interaction (B = 0.7, $t(136)$ = 1.71, p = 0.088, semipartial r^2 = 0.01). Women highly identified with the domain and gender performed better on the math test than women highly identified with math who did not identify strongly with gender, $t(144)$ = 2.25, p = 0.026. At low levels of gender identification, women highly identified with math performed better than women less identified with math, $t(144)$ = 2.62. Similarly, at low levels of gender identification, women

be more challenging than section one, which turned out to be the case, $t(147) = 6.44$, $p < 0.0001$. The participants solved fewer problems correctly in section two compared to section one ($M_{section1} = 4.53$, $M_{section2} = 3.58$, $M_{overall} = 8.12$).

When analyzing the test by sections, we would expect to see stronger effects of stereotype threat in the more difficult second section of the exam compared to section one. This prediction is consistent with stereotype threat theory stating that stereotype threat effects are more pronounced on difficult math tests (Spencer et al., 1999). The statistical analyses performed on the first section of the math exam did not yield any significant results, $p > 0.2$, except for the main effect of domain identification ($B = 0.068$, $t(136) = 3.53$, $p = 0.001$, semipartial $r^2 = 0.08$). The higher the domain identification, the better the test score on the first section of the test. Math score in section two was predicted by domain identification measured in mass testing ($B = 0.084$, $t(136) = 4.95$, $p < 0.0001$, semipartial $r^2 = 0.137$), and gender identification measured in mass testing ($B = 0.434$, $t(136) = 2.55$, $p = 0.012$, semipartial $r^2 = 0.036$). The more the participants identified with math and gender, the better they did on the second section of the test. These two main effects were qualified by a marginally significant interaction ($B = 0.44$, $t(136) = 1.89$, $p = 0.061$, semipartial $r^2 = 0.02$). For women highly identified with math, those who were identified with gender performed better on the test than women less

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highly identified with math performed better than women less identified with math, $t(144) = 5.11$, $p < 0.001$. The Affirmation Level X Domain Identification interaction involving the self-affirmation vs. group-affirmation comparison and domain identification was significant ($B = 0.8$, $t(136) = 2.17$, $p = 0.032$, semipartial $r^2 = 0.026$). Simple slopes analyses revealed that in the self-affirmation condition high domain identifiers performed better on the test than low domain identifiers, $t(142) = 4.2$, $p < 0.0001$. The difference between the performance of high and low domain identifiers in the group-affirmation condition was marginally significant, $t(142) = 1.7$, $p = 0.08$. High domain identifiers tended to perform better than low domain identifiers in the group-affirmation condition. High domain identifiers tended to perform better in the self-affirmation condition compared to group-affirmation condition, $t(142) = 1.84$, $p = 0.067$.

identified with gender, $t(144) = 2.5$, $p = 0.013$. Women less identified with math performed at a similar level no matter how much they identified with gender, $t(144) = 0.46$, $p = 0.645$. The performance of women less identified with math was lower than the performance of women highly identified with math at high levels of gender identification, $t(144) = 4.98$, $p < 0.0001$, and low levels of gender identification, $t(144) = 2.49$, $p = 0.014$.

The results for the affirmation contrasts were as follows. Participants' math performance in the self-affirmation condition did not differ significantly from the math performance in the no-affirmation condition ($B = -0.137$, $t(136) = -0.88$, $p = 0.377$, semipartial $r^2 = 0.004$). The math score in the group-affirmation condition did not differ significantly from the math score in the no-affirmation condition ($B = -0.13$, $t(136) = -0.85$, $p = 0.397$, semipartial $r^2 = 0.004$). The difference between the math score in the self-affirmation condition and the math score in the group-affirmation condition was marginally significant ($B = 0.267$, $t(136) = 1.75$, $p = 0.083$, semipartial $r^2 = 0.017$). The participants in the self-affirmation condition tended to perform better than the participants in the group-affirmation condition ($M_{\text{self-affirm}} = 3.77$ vs. $M_{\text{group-affirm}} = 3.37$). Contrary to what we predicted, domain and gender identification did not moderate the math performance in different experimental conditions. The predicted Affirmation Level X Domain Identification X Gender Identification interactions were not significant in the self-affirmation vs. no-affirmation comparison, $t(136) = -0.93$, $p = 0.356$, the group-affirmation vs. no-affirmation comparison, $t(136) = 1.02$, $p = 0.308$, and in the self-affirmation vs. group-affirmation comparison, $t(136) = 0.09$, $p = 0.931$.

Even though the predicted three-way interactions were insignificant, the Affirmation Level X Domain Identification interaction involving the self-affirmation vs. group-affirmation comparison and domain identification was significant ($B = 0.47$, $t(136) = 2.24$, $p = 0.026$, semipartial $r^2 = 0.017$, see Figure 1). Simple slope analyses revealed that in the self-affirmation condition, high domain identifiers performed better on the test than low domain identifiers, $t(142) = 4.1$, $p < 0.0001$. High and low domain identifiers did not differ in how they performed on the test in the group-affirmation condition, $t(142) = 1.31$, $p = 0.192$. Moreover, high domain identifiers performed better when they affirmed the self compared to when they affirmed the group, $t(142) = 2.41$, $p = 0.017$. This pattern of results indicates that group-affirmation had a detrimental effect on the participants highly identified with math.

There was no significant difference in how low domain identifiers did on the test depending on whether they affirmed the self or the group, $t(142) = -0.64$, $p = 0.523$. Neither group, nor self-affirmation had a positive effect on women less identified with math.

In addition, the two-way interaction of the no-affirmation vs. group-affirmation comparison and domain identification was significant ($B = -0.4$, $t(136) = -1.99$, $p = 0.048$, semipartial $r^2 = 0.022$, see Figure 2). This interaction pattern was similar to the interaction between the self-affirmation vs. group-affirmation comparison and the domain identification. Simple slope analyses revealed that in the no-affirmation condition, high domain identifiers performed better on the test than low domain identifiers, $t(142) = 3.5$, $p < 0.001$. High and low domain identifiers did not differ in how they performed on the test in the group-affirmation condition, $t(142) = 1.309$, $p = 0.192$. Again, this pattern

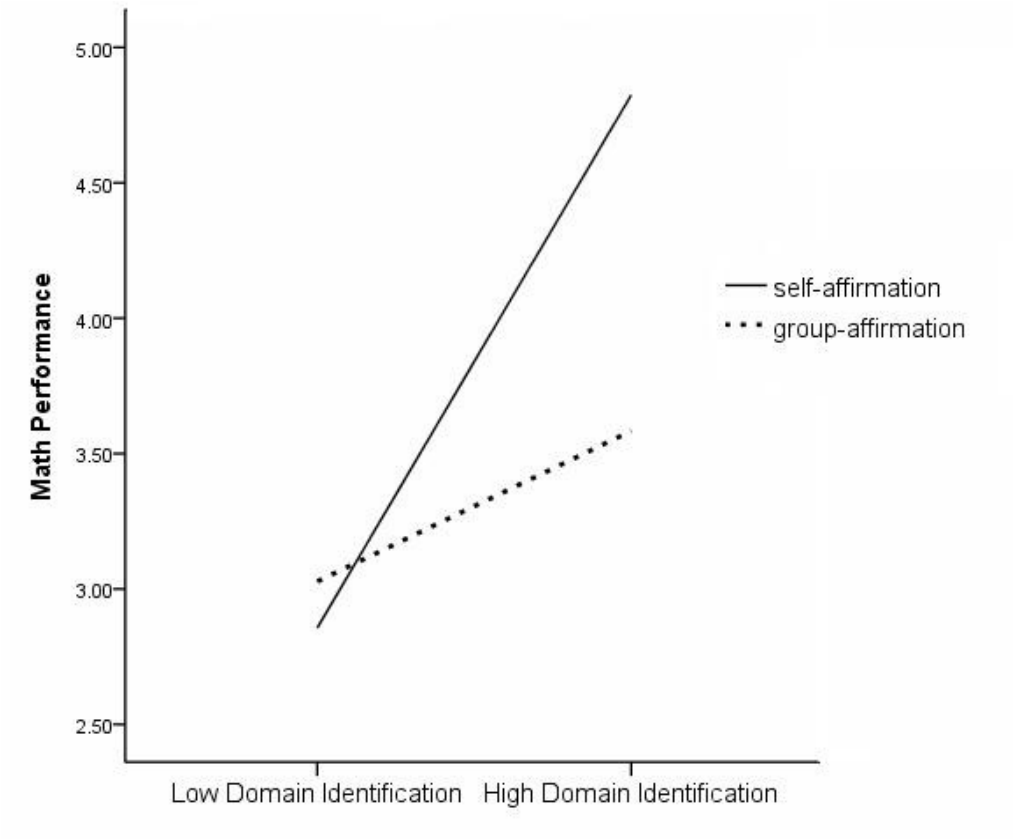

Figure 1. Math performance in the self- and group-affirmation condition for low (-1 *SD*) and high domain identifiers (+1 *SD*).

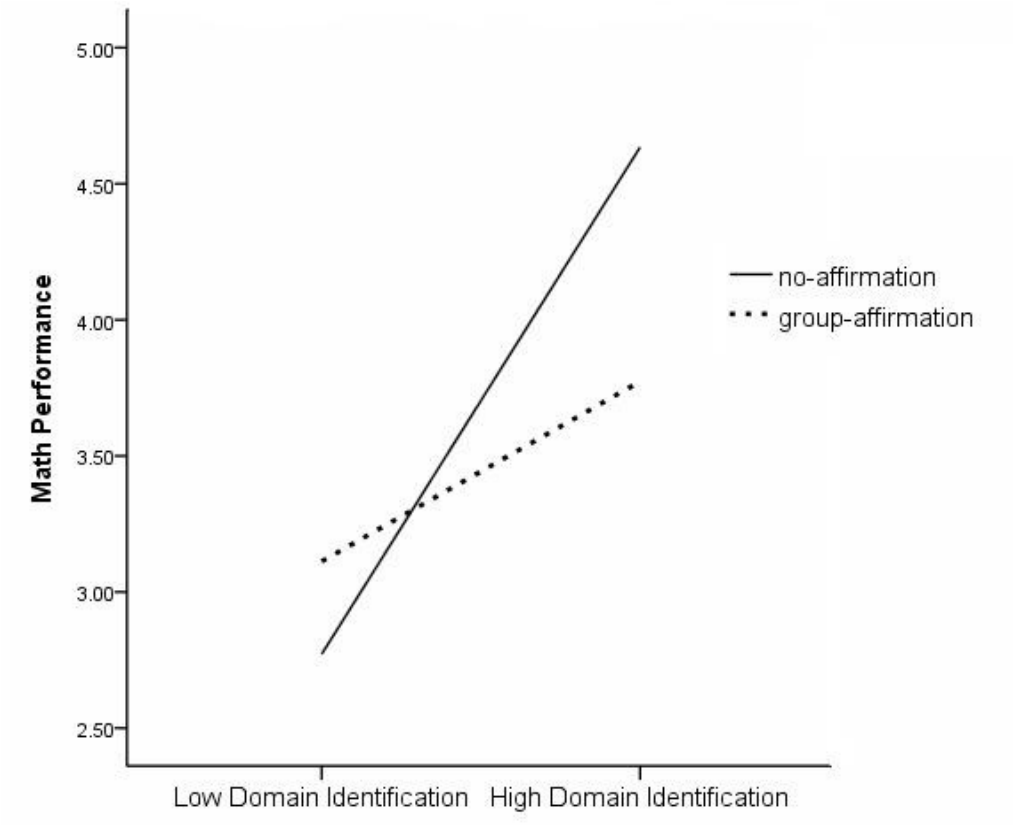

Figure 2. Math performance in the no- and group-affirmation condition for low (-1 *SD*) and high domain identifiers (+1 *SD*).

indicates that group-affirmation had a negative effect on the participants highly identified with math, compared to when they did not affirm at all. In addition, there was a difference in how high domain identifiers did on the test depending on the condition, but it did not approach significance, $t(142) = -1.533$, $p = 0.128$. The difference in how low domain identifiers did on the test depending on the condition was insignificant, $t(142) = 0.7$, $p = 0.487$.

Postexam questions

Participants' evaluations of the exam (exam's difficulty, how interesting versus boring it was, and how much the participants enjoyed working on the exam) were not affected by affirmation level, $p > 0.3$. Participants' level of gender identification taken in mass testing did not differ from the score on the Gender Identification Scale ($\alpha = 0.805$) taken after the test, and it was not affected by the affirmation condition they were in, $p > 1$. There was a significant change in how much participants identified with mathematics before the math exam and after the exam (postexam Domain Identification Measure, $\alpha = 0.912$), $F(1,145) = 16.99$, $p < 0.0001$. Before the exam participants identified with the math more strongly than after the exam, $M_{pre\text{-}exam} = 27.96$ vs. $M_{post\text{-}exam} = 26.55$.

DISCUSSION

The aim of the study was to test whether group-affirmation can alleviate the negative effect of stereotype threat on math performance, and to compare the effects of self- and group-affirmation on stereotype threat-induced underperformance. In addition, we aimed to test whether positive effects of self-affirmation and group-affirmation are moderated by the level of gender and domain identification in participants. Based on previous findings about the moderating effects of gender and domain identification in affirmation and stereotype threat theories, we predicted that women who affirmed either the self or the group would exhibit different math performance patterns depending on how much they identified with math and gender. More specifically, we expected that both self- and group-affirmation would boost the math performance of women who strongly identified with gender and math compared to women who strongly identified with gender but did not strongly identify with math. Moreover, we expected that group-affirmation may have a negative effect on women who did not strongly identify with their gender but identified strongly with mathematics due to the assumption that those less identified with their gender disidentify with their gender to cope with stereotype threat (Pronin et al., 2004; Steele, 1997).

Not surprisingly, we found that women highly identified with math did better on the test, compared to women less identified with math (Smith & White, 2002; Steele,

1997). Somewhat surprisingly, given that all participants in our study were exposed to stereotype threat information, we found that women more identified with gender performed better on the test compared to women less identified with gender. However, this main effect may be partially due to the gender-math identification interaction found in our study.

The results of our study did not provide a consistent support for the theoretical argument that group-affirmation would alleviate the negative effects of stereotype threat on performance. We found the opposite effect; women who affirmed the group underperformed on the math test compared to women who affirmed the self or did not affirm at all. In addition, our predictions that self and group-affirmation effects would be moderated by gender and math identification were not fully supported. We did not find any moderating effects of gender identification but we did find that domain identification moderated affirmation. More specifically, group-affirmation impaired the math performance of women highly identified with math. This result is contrary to what is known about the influence of positive group characteristics and role models on stereotype threat (Gresky et al., 2005; Marx & Roman, 2002; McIntyre et al., 2003; Shih et al., 1999; Stout, Dasgupta, Hunsinger, & McManus, 2011). In these studies, participants who were exposed to role models that were portrayed explicitly as doing well in a stigmatized domain or other domains (e.g., a female students successful in mathematics, women successful in architecture and medicine) or who shifted focus to positive social identities alternative to the stigmatized identity (e.g., Asian or college student) were able to do well in a stigmatized domain even though they were performing under stereotype threat.

Group-affirmation, as it was applied in our study, had an opposite effect to what was found in studies about positive group identities or positive role models, possibly due to its different qualities. In the studies with positive role models, participants are given the opportunity to compare themselves with successful, competent members of the stigmatized group. If role models are not portrayed as competent, they do not have the positive effect (Marx & Roman, 2002). Comparisons with in-group role models inoculate from stereotype threat through several different mechanism: they positively affect the ability appraisals or self-efficacy in the stereotyped domain (Elizaga & Markman, 2008; Marx & Roman, 2002; McIntyre et al., 2003; Stout et al., 2011), they nullify the threat (i.e., other members of my group did well in this situation, so the stereotype does not apply to this situation), or they reduce the pressure to make a good impression in the testing situation (i.e., other members of my group performed well in this domain and disconfirmed the stereotype so I do not have to try to make a good impression or disconfirm the stereotype, Marx et al., 2005).

In the studies using positive group identities, participants were given the opportunity to think about social groups they belong to other than the stigmatized group, which allowed them to divert their thoughts away from the stigmatized identity (Gresky et al., 2005; Shih et al., 1999) and think about themselves as members of different, more positive social groups. When the stigmatized identity was no longer salient in stereotype threat context, it allowed the participants to perform better in the stigmatized domain (Rydell et al., 2009).

We proposed that group-affirmation could enhance the global sense of self-worth in the face of stereotype threat in people who valued the stereotyped group and the

stereotyped domain. In our study, participants were asked to reflect on values and characteristics important for the stigmatized group but unrelated to the stigmatized domain and this resulted in performance decrements. In the case of group-affirmation, participants kept the stigmatized group in mind when they affirmed. If one affirms as a member of a stigmatized group, this activates the stigmatized collective identity (Derks et al., 2009). In the stereotype threat situation, having a stigmatized group in mind while performing may lead to performance decrements (Ambady et al., 2004; Rydell et al., 2009), which may explain why group-affirmation did not work as we predicted. Other methods focused on comparisons with specific in-group members who were doing well in a stereotyped domain or using other positive group identities different than the stigmatized group could be more effective than trying to repair one's own self-worth through restoring the positive image of the whole group.

Interestingly, in our study, self-affirmation did prove to be more beneficial than group-affirmation, but we did not replicate the beneficial effects of self-affirmation compared to no-affirmation. The way we manipulated affirmation made it possible that people who were not given the opportunity to affirm, somehow still self-affirmed. The participants were supposed to choose a value that was the most important for other people and then write about the value they ranked as the least important for others. Thinking about values' importance or unimportance to others could bring into mind important personal values; therefore, it is possible that the participants in the no-affirmation condition somehow self-affirmed.

We also found that women highly identified with both math and gender got better results on the math test than women highly identified with math but less identified with

gender. In stereotype threat theory, if someone considers the domain and group important, there is more potential for stereotype threat to occur when they engage the domain (e.g., performance). Therefore, stereotype threat is believed to have a greater negative impact on people highly identified with math and gender (Schmader, 2002; Steele, 1997). Given that we found an opposite pattern, could there be circumstances under which strongly math and gender identified women are more eager to reject the stereotype and protect their identity and their performance? Indeed, some people can respond to stereotype threat with reactance (Kray, Thompson, & Galinsky, 2001), particularly when stereotype threat is evoked explicitly (Nguyen & Ryan, 2008). That is, sometimes, when people realize that they are being exposed to stereotype threat, they may have a strong reaction against the stereotype and are eager to reject it, which results in counter-stereotypical behaviors (e.g., enhanced performance). When the stereotype is blatant, it may be easier to find obvious arguments against it and reject it as opposed to when the stereotype threat is evoked implicitly (Nguyen & Ryan, 2008). For example, Kray and colleagues (2001) showed that when women were exposed to an explicit, negative stereotype that compared their negotiation skills with men's negotiation skills, this blatant stereotyping evoked reactance in women, resulting in behaviors disconfirming the stereotype. Since stereotype threat was explicitly evoked in our study it could have induced stereotype reactance in women highly identified with math and gender. Women for whom gender is an important part of their self-concept, and who identify with math and consider themselves good at math, may be more eager to reject the negative stereotype and to act in a way to disconfirm it in order to protect these parts of their identity. In addition, a combination of strong math identification and strong gender

identification may provide the means to successfully alleviate stereotype threat. These women believe that they are good at math and they are invested in math, which suggests that they have the skills to perform well. At the same time, these women care about their gender, which makes them more willing and able to deem the stereotype untrue and protect their female identity by disconfirming the stereotype, especially in the situation when the stereotype is blatant and the threat is explicit. On the other hand, women who are identified with math but do not strongly identify with gender could not respond to the stereotype with reactance. If they do not consider being a woman important, they may not be willing to protect the female identity in the face of stereotype threat by rejecting or disconfirming the negative stereotypes about women. In addition, if they accept the stereotype as true for women in general, it may impair their performance (Schmader, Johns, & Barquissau, 2004).

Lastly, in our study we found that women who affirmed their group reported that they were more motivated to do well on the math test compared to women who affirmed the self. This result is consistent with other stereotype threat studies (Derks, van Laar, & Ellemers, 2007; Derks et al., 2009). Even though group-affirmation increased the motivation to perform well in the stigmatized domain, greater motivation did not facilitate better math performance under stereotype threat. Participants under stereotype threat typically report high motivation to perform well on the task possibly because they do not want to confirm the stereotype. However, when motivation to perform is high, it can impair working memory and performance (Schmader et al., 2008).

LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Our study has several limitations that should be addressed. At the same time, we propose improvements and suggestions for further research.

Math Test

We argue that the second part of the test was more difficult than the first part of the test. The first part of the test was based on the GRE general quantitative test, the second part was based on the GRE Subject Test in mathematics. Indeed, we found that participants had better scores on the first part of the test compared to the second part of the test. We also found that the effects of stereotype threat and affirmation were more pronounced in the more difficult part of the test, which is consistent with the stereotype threat theory. However, there is an alternative explanation for the differences in performance between the two sections of the test. Participants could have done worse on the second section due to fatigue because in our study, the second section of the test always followed the first section. In future experiments, we should alternate the order of the two sections to control for such effects as fatigue.

Stereotype Threat Manipulation

The present study lacked a "no-threat" comparison group in which participants would only take the math test without any prior instructions. We did not include the "no-threat" comparison group because our primary goal was to compare the group-affirmation effects to self-affirmation. We know from previous research that self-affirmation alleviates stereotype threat (Cohen et al., 2006; Martens et al., 2006); therefore, in our study, the self-affirmation condition worked as a proper comparison group. Nonetheless, if we had included a "no-threat" comparison group, we might have been able to better understand some results we did not expect to get. For example, math performance in our study was on average quite low. Participants solved less than a half of the problems correctly in each section of the test and on the test overall, which suggests that even people highly identified with math did quite poorly. If we had a comparison group consisting of high domain identifiers not exposed to stereotype threat, maybe their performance would have been better than the performance of high identifiers who were exposed to stereotype threat. Since we do not have a proper comparison group, we cannot draw any meaningful conclusions about this result.

Affirmation Manipulation

We did not include any measures that would help us understand how the affirmation manipulation influenced the participants. Based on previous research (see Sherman & Cohen, 2006 for a review), we assumed that self and group-affirmation, as it was applied in our study, would restore the participants' sense of self-worth after they had been threatened. However, we did not include any tools in our study to test this

assumption. As a result, at this point in our research, we can state that self-affirmation had a more beneficial effect on women under stereotype threat than group-affirmation, but we cannot explain why they had different effects.

Furthermore, our results show that the effects of self-affirmation were not any different from the effects of no-affirmation. This finding suggests that the participants in the no-affirmation condition could have somehow affirmed even though they were not expected to. Alternatively, other mechanisms unrelated to affirmation such as trivialization of stereotype threat (Simon, Greenberg, & Brehm, 1995) could have been responsible for self and no-affirmation effects. It is impossible to distinguish what exactly the three different affirmation contexts (no- vs. self- vs. group-affirmation) evoked in participants without having additional measures tapping into the mechanisms underlying affirmation. In future experiments, we should include measures that would help us to evaluate the affirmation effects (i.e., whether self and group-affirmation restored the participants' global sense of self-worth after they were threatened). For instance, measures of state self-esteem (Derks et al., 2009; Heatherton & Polivy, 1991) and collective self-esteem (Luhtanen & Crocker, 1992) could be used to improve our research.

Another important question concerning the negative results of group-affirmation should be addressed in future research. Why did group-affirmation cause the performance to drop under stereotype threat? Is affirming as a member of a stigmatized group detrimental because it increases the salience of the threatened identity? To answer this question, in future studies, we could measure the accessibility of the threatened identity (e.g., Rydell et al., 2009) in different affirmation conditions and test if the accessibility of

the threatened identity mediates the performance effects under stereotype threat. It would also be interesting to include a new condition in which the participants affirm as members of a group unrelated to the stereotype and test if this kind of group-affirmation differs from the group-affirmation we used in the current study.

We also found that participants in the group-affirmation condition were more motivated to do well on the test than the participants in the self-affirmation condition. Even though the participants were more motivated to do well on the test when they affirmed the group, they underperformed compared to the participants in the self-affirmation condition. Is it possible that higher motivation to perform well can be detrimental and contribute to the underperformance instead of helping the participants perform well? We propose additional mediational analysis to test if motivation accounted for the performance decrements in group-affirmation condition under stereotype threat.

CONCLUSION

The results of our study show that group-affirmation in a stereotype threat situation may be harmful for the math performance of some women. In our study, women who were exposed to stereotype threat and affirmed as members of the stigmatized group underperformed on a difficult math test compared to women who affirmed the self. Thus, group-affirmation turned out to be detrimental in a stereotype threat situation, particularly for women who valued math. This negative outcome could be due to the fact that women in the group-affirmation condition were told to affirm as members of the stigmatized group. When group-affirmation is related to the stigmatized identity it may intensify the stereotype threat effects instead of lifting the threat. It may be possible that for group-affirmation to lift the stereotype threat a person would have to affirm as a member of a group unrelated to the threat.

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